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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

INFORMATION DOCUMENT

ATN AIR/GROUND ROUTER SUB-NETWORK SERVICE PROVIDER TO PRIMARY GROUND NETWORK INTERFACE DATA PORT

The NEXCOM Integrated Product Team, AND-360

RECORD OF CHANGES

Revision	Date	Action
0.0	4/16/2002	ID 02/11/02 Draft Baselined as Revision 0.0

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1.0 INTRODUCTION

1.1 Scope

This Interface Control Document (ICD) describes the design characteristics for the interfaces between the Aeronautical Telecomunications Network (ATN) Air/Ground (A/G) Subnetwork Services (A/G SNS) and the Primary Ground Network Interface Data (PGNI-D) port.

1.2 Subsystem Responsibility List

Table 1-1 identifies the subsystems and the responsible Federal Aviation Administration (FAA) Office.

Table 1-1

Subsystem Responsibility List

Subsystem	Common Name	FAA-Office
A/G-SNS	ATN Air/Ground Subnetwork Services	AND-360
P-GNI-D	Primary GNI Data Interface	AND-360

1.3 Document Organization

This document is written in accordance with FAA-STD-025d and organized as follows: Section 1, SCOPE, identifies the interfacing systems and provides a summary of the contents of this document.

Section 2, APPLICABLE DOCUMENTS, provides a list of referenced documents, including both Government and Non-government documents.

Section 3, INTERFACE DESIGN CHARACTERISTICS, provides the general, functional, and physical information about the interface.

Section 4, QUALITY ASSURANCE PROVISIONS, provides a description of the verification process for the requirements presented in Section 3.

Section 5, PREPARATION FOR DELIVERY, specifies any special preparation requirements for delivery.

Section 6, NOTES, provides a list of applicable definitions used in this document.

Appendix A provides a 1Verification Requirements Testability Matrix for the requirements in this document.

Appendix B provides a list of abbreviations and acronyms used in this document.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. The following references are the documents used, by date, in this standard.

2.1 Government Documents

STANDARDS:

FAA-STD-025d	Preparation of Interface Documentation Standards, October 1995
FAA-STD-057	Airport Fiber Optic Communication System Standards, DRAFT
47 CFR	Code of Federal Regulations, Title 47, FCC Rules and Regulations, Part 68, Revised 1 October 1998

DOCUMENTS:

FAA-E-2958	Next Generation Air/Ground Communications (NEXCOM) System Requirements Document (SRD)April 16, 2002, V1.0
FAA-E-2938	Subsystem Specification, Multimode Digital Radio (MDR),April 16 2002, V5.0

2.2 Non-Government Documents

ANSI:

ANSI/TIA/EIA 530-A	High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment, Including Alternative 26-Position Connector (ANSI/TIA/EIA-530-A-92) (R98)

ICAO:

VHF Digital Link (VDL) TDMA Mode (Mode 3) Standards and Recommended Practices (SARPS) Annex 10, Volume III, Part 1, Chapter 6

ISO/IEC:

ISO/IEC 3309	Information Technology – Telecommunications and Information Exchange Between Systems – High-level Data Link Control (HDLC) Procedures – Frame Structure, 1993
ISO/IEC 4335	Information Technology – Telecommunications and Information Exchange Between Systems – High-level Data Link Control (HDLC) Procedures – Elements of Procedures, 1993

ISO/IEC 7498	Information Technology – Open Systems Interconnection – Basic Reference Model, November 1994
ISO/IEC 7809	Information Technology - Telecommunications and Information Exchange Between Systems - High-level Data Link Control (HDLC) Procedures - Classes of Procedures, 1993
ISO/IEC 7776	Information Processing Systems - Data Communication - High Level Data Link Control Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures

RTCA:

RTCA DO-224a	Signal in Space Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Capability with Digital Voice Technique

2.3 Document Sources

2.3.1 FAA Documents

Copies of FAA specifications, standards, and publications may be obtained from the Contracting Officer, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591. Requests should clearly identify the desired material by number and date, and state the intended use of the material.

2.3.2 Military and Federal Documents

Single copies of unclassified military and federal specifications, standards, and publications may be obtained by writing the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA, 19120; or by calling (215) 697-3321 Monday through Friday, 8:00 a.m. to 4:30 p.m. Eastern Standard Time (EST).

2.3.3 American National Standards Institute and International Organization of Standardization Documents

Copies of American National Standards Institute (ANSI) and International Organization of Standardization (ISO) documents may be obtained from the American National Standards Institute, 11 West 42nd Street, New York, NY, 10036, or through the web site http://www.ansi.org.

2.3.4 International Civil Aviation Organization Documents

Copies of final products of International Civil Aviation Organization (ICAO) documents may be obtained from the ICAO Library is 999 University Street, Montreal, Quebec H3C 5H7, Canada, or through the web site http://www.icao.org.

2.3.5 International Telecommunications Union Telecommunication Standardization Sector Documents

Copies of International Telecommunications Union Telecommunication Standardization Sector (ITU-T) documents may be obtained from the ITU, Place des Nations, CH-1211 Geneva 20, Switzerland, through the web site http://www.itu.int.

2.3.6 RTCA Documents

Copies of RTCA documents may be obtained from the RTCA Inc., 1140 Connecticut Avenue, N.W., Suite 1020, Washington, DC 20036-4001 or by calling (202) 833-9339, or through the web site http://www.rtca.org.

3.0 INTERFACE DESIGN CHARACTERISTICS

This section specifies the general, functional, and physical design characteristics of the A/G-SNS to PGNI-D interface.

3.1 General Design Characteristics

The general design characteristics are based on the subsystem definitions, the interface design considerations, and planned operational configurations.

3.1.1 Subsystem Definition

3.1.1.1 Primary Ground Network Interface - Data

The functions provided by the PGNI-D are summarized as follows:

a) Transmission of data packets to and reception of packets from the A/G SNS entity.
b) Routing, merging and separation of data packet streams to/from the RIU's and Secondary Ground Network Interfaces (SGNI-D's).

3.1.1.2 A/G Sub Network Services

The A/G SNS will provide the interface between the ATN router, non-ATN services and the PGNI-D. The function of the A/G SNS will be to provide:

a) The Internetworking Function (IW), packet multiplexor and compressor for the ISO 8208 to VDL Mode 3 Packet Layer Protocol (PLP) interface.
b) The IW and compressor for the ISO 8473 CLNP (ConnectionLess Network Protocol) to ISO 8473 CLNP Compression interface.
c) ISO 8473 CLNP uncompressed interface
d) ISO 8208 uncompressed interface
e) Provide a non-ATN data interface

3.1.2 Interface Design Considerations

The interface between the PGNI-D and the AG-SNS carries two distinct types of information:

a) Payload data
b) Control and Status (e.g. aircraft datalink capability, uplink delivery notification etc.)

It is assumed that the A/G SNS and the PGNI-D could be sited together or at separate locations.

3.1.3 Operational Configurations

Figure 3-1 depicts the configuration supported by the interface defined in this ICD. The A/G-SNS to PGNI-D interface consists of a standard ANSI/TIA/EIA 530A port. Figure 3-1 also illustrates the typical operational configuration. AG-SNS will be defined as the DTE and the PGNI-D as the DCE.

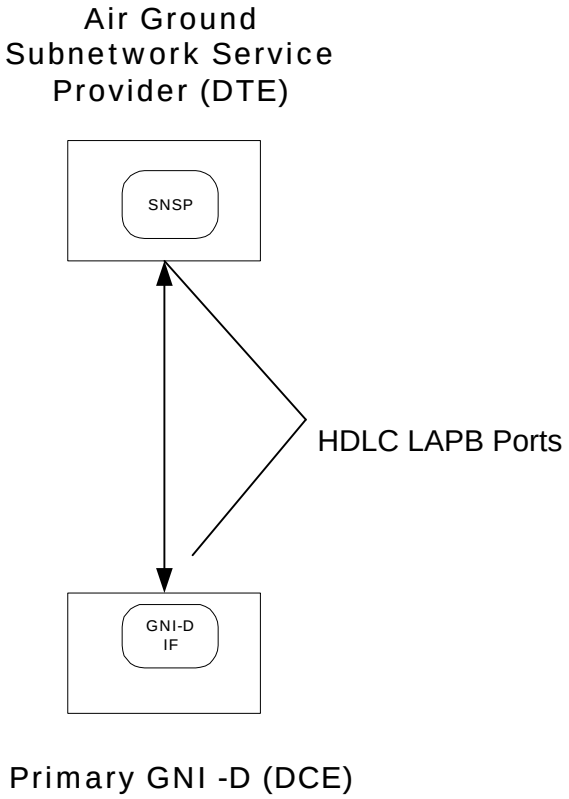


Figure 3-1

Operational Configuration of PGNI-D with respect to

A/G Sub Network Service Provider

3.1.4 Interface Boundary Points

All requirements imposed by this document on either the PGNI-D or the A/G-SNS are applicable to and measured at the interface boundaries. The interface boundary for the PGNI-D is the 25 way D-Type connector on the PGNI-D. The interface boundary for the A/G SNS is the 25 way D-Type connector on the A/G-SNS.

3.2 Functional Design Characteristics

The PGNI-D/A/G-SNS Interface is organized according to the ISO/IEC 7498, Information Technology – Open Systems Interconnection – Basic Reference Model. The design for this interface utilizes three of the seven OSI-type interface layers, the Application Layer (level 7),

Data Link Layer (level 2) and Physical Layer (level 1). Although referenced in this document, levels 3 through 6 are not applicable.

3.2.1 Application Processes

3.2.2 OSI-type Data Interface

3.2.2.1 Application Layer

3.2.2.1.1 Data Services

a) The A/G-SNS **shall** [2] send and receive Application Data Units (ADU's) to and from the PGNI-D Port.
b) These ADU's **shall** [4] be encapsulated as information frames using the LAPB (ISO 7776) link level protocol, which provides peer to peer data integrity.

The basic unit of transmission is the frame, which is a bit sequence containing at least 32 bits between flags (eight address, eight control, and 16 frame check sequence bits).

c) All non-segmented messages or individual message segments (of a segmented message) sent between the PGNI-D and A/G-SNS **shall** [6] be transmitted within one frame.

3.2.2.1.1.1 General Message Structure

The general message structure is comprised of the Message ID and Message Type. The Message ID values and Message Type identifiers are defined in Table 3-1, Message Transmission Capability. This table also defines the transmission source associated with each Message Type for the A/G-SNS/PGNI-D link.

Table 3-1

Message Transmission Capability

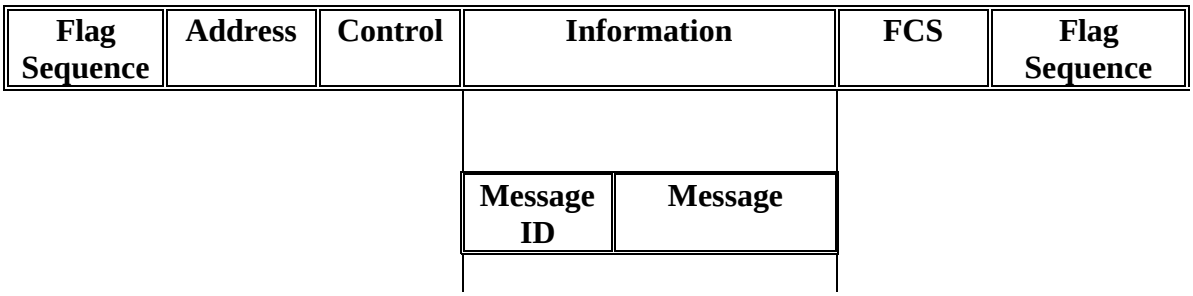
Message ID	Message Type	A/G-SNS PGNI-D Link	
		A/G-SNS	PGNI-D
1	Aircraft State Message		X
2	Datalink Capability Message		X
3	Downlink Data Message		X
4	Uplink Delivery Message		X
5	PGNI-D Uplink Message Rejection		X
6	Ground DTE Address Notification		X
6-127	Reserved		
128	Aircraft Status Message	X	
129	Uplink Data Message	X	
130-255	Reserved		

a) A message **shall** [8] be contained within an I field of a I frame.
b) Each message exchanged across the data interface **shall** [10] contain a one octet Message ID followed by the message.

The UI frame and its components are illustrated in Figure 3-2 Application Message Structure.

Table 3-2

Application Message Structure



c) The message format diagrams in the remainder of this section specify bit 1 of each octet **shall** [12] be the first bit transmitted.

3.2.2.1.1.2 PGNI-D to A/G-SNS ADUs

3.2.2.1.1.2.1 Aircraft State Message

a) This ADU **shall** [14] be sent by the PGNI-D during the VDL Mode 3 Net Entry procedure and indicates to the A/G-SNS that the aircraft can be reached through this PGNI-D.
b) The A/G SNS will check the connection status of the aircraft based on the ICAO address and **shall** [16] respond with an Aircraft Status Message with either a "previous link known" or "previous link unknown" content.

Table 3-3

Aircraft State Message Format

Octet	Parameters	Value or Range
1	MID	01 h – Aircraft State Message
2	24 bit ICAO address MSB	24 bit ICAO address
3		
4	LSB	

3.2.2.1.1.2.2 Data Link Capability Message

a) The Data Link Capability Message **shall** [18] be generated by the PGNI-D during initial link negotiation.

VDL Mode 3 initial link negotiation is established by an exchange of XID parameters initiated from the aircraft. The aircraft will send a number of DLS CTRL_CMD_LE frame(s) with information regarding its support of the various networks, to which the ground will confirm support with a CTRL_RSP_LE. The aircraft may support multiple networks and therefore a number of Data Link Capability Messages may be relayed by the PGNI-D to the A/G-SNS, giving notice to the A/G ATN Router of the network capability of the aircraft.

Table 3-4

Data Link Capability Message

Octet	Parameters	Value or Range
1	MID	02 h Data Link Capability Message
2	24 bit ICAO address MSB	24 bit ICAO address
3		
4	LSB	
5	Number of Networks	0-255
6	Network Type Value	0 – ATN/ISO 8208/VDL M3 PLP Compression 1 - ATN/ISO 8473/VDL M3 CLNP Compression 2 – ATN/ISO 8208 (No Subnetwork Compression 3 – ATN/ISO 8473 (No Subnetwork Compression 4 – Non ATN data

3.2.2.1.1.2.3 Downlink Data Message

a) The Downlink Data Message contains the ADU received from the aircraft and **shall** [20] be sent by the PGNI-D to the A/G-SNS interface.
b) The Downlink Data Message **shall** [22] be an unacknowledged message at the application layer and will contain the following fields.

Table 3-5

Downlink Data Message Format

Octet	Parameters	Value or Range
1	MID	03 h GNI D/L Data Message
2	24 bit ICAO address MSB	24 bit ICAO address
3		
4	LSB	
5	Network Type Value Identifier (NTVI)	0 – ATN/ISO 8208/VDL M3 PLP Compression 1 - ATN/ISO 8473/VDL M3 CLNP Compression 2 – ATN/ISO 8208 (No Subnetwork Compression 3 – ATN/ISO 8473 (No Subnetwork Compression
6	Priority	Data Priority 0 – 3 as mapped in the VDL Mode 3 DLS frame
7 to N	DATA	An integral number of octets of data requested to be sent, defined by the NTVI.

3.2.2.1.1.2.4 Uplink Delivery Notification

a) The Uplink Delivery Notification **shall** [24] be sent to the A/G-SNS by the PGNI-D after an Uplink Data Message has been successfully delivered to the MDR for transmission.

Table 3-6

Uplink Delivery Notification Format

Octet	Parameters	Value or Range
1	MID	04 h GNI Uplink Delivery Notification
2	24 bit ICAO address MSB	24 bit ICAO address
3	LSB	
4	Message Number	Message number of the uplink data request sent to MDR for transmission

3.2.2.1.1.2.5 Uplink Message Rejection notification

a) The Message Rejection Notification **shall** [26] be generated and sent to the A/G-SNS by the PGNI-D in response to an uplink data message that was unable to be delivered to the MDR for transmission.

The Message Rejection Notification provides the reason code for rejection.

Table 3-7

Uplink Message Rejection notification Format

Octet	Parameters	Value or Range
1	MID	05h PGNI-D Uplink Message Rejection
2	24 bit ICAO address MSB	24 bit ICAO address
3	LSB	
4	Message Number	Message number of the uplink data request that rejected
5	Reason	1h Aircraft no longer serviced by PGNI-D

3.2.2.1.1.2.6 Ground DTE Address Notification

a) The Ground DTE Address **shall**[28] be passed to the AG-SNS after the LAPB link has initialized.

The AG-SNS acts as the DTE and requires this address in order to support sub network operations.

b) The Ground DTE Address **shall**[30] have a total length of 3 Binary Coded Decimal (BCD) digits, as follows:

$X_0X_1X_2$ (X_0 **shall**[32] be the most significant digit)

c) The Ground DTE address **shall**[34] be in the range of 0 through 255.

Table 3-8

Ground DTE Address Notification Format

Octet	Parameters	Value or Range
1	MID	06h PGNI-D DTE Address Notification
2	MSB	12 bit BCD Ground DTE Address.
3	LSB	

d) The four MSB's **shall**[36] be filled with zeros, as only 4 bits of the first octet are required.

3.2.2.1.1.3 A/G SNS to Primary GNI ADUs

3.2.2.1.1.3.1 Aircraft Status Message

a) The Aircraft Link Status Message **shall** [38] be generated by the A/G-SNS interface in response to the Aircraft State Message.

It is a notification to the PGNI-D of the current A/G router link status of the Aircraft.

b) The PGNI-D **shall** [40] receive a Previous Link Known message from the A/G-SNS in response to the Aircraft State Message when the aircraft is already currently connected to the A/G Router served by the A/G SNS.

This will occur when an aircraft initializes to an MDR served by the same PGNI-D (and hence A/G router) as the previous MDR.

c) If the A/G router does not recognize the previous link to the aircraft, a Join Event message will be initiated by the A/G router and a Previous Link Unknown message **shall** [42] be sent to the PGNI-D.

This will occur when an aircraft initializes to an MDR served by a different PGNI-D (and hence A/G router) than the previous MDR.

Table 3-9

Aircraft Status Message Format

Octet	Parameters	Value or Range
1	MID	80 h – Aircraft Status Message
2	24 bit ICAO address MSB	24 bit ICAO address
3	LSB	
4	Status	0 h Previous Link Known 1 h Previous Link Unknown

3.2.2.1.1.3.2 Uplink Data Message

a) The Aircraft Data Request Message contains the ADU received from the ATN router and **shall** [44] be passed from the A/G SNS to the PGNI-D.
b) The Uplink Data Message **shall** [46] be acknowledged from the PGNI-D by either an Uplink Delivery Notification or Uplink delivery Rejection Messageand will contain the following fields.

Table 3-10

Uplink Data Message Format

Octet	Parameters	Value or Range
1	MID	81 h A/G-SNS U/L Data Message
2	24 bit ICAO address MSB	24 bit ICAO address
3		
4	LSB	
5	Network Type Value Identifier (NTVI)	0 – ATN/ISO 8208/VDL M3 PLP Compression 1 - ATN/ISO 8473/VDL M3 CLNP Compression 2 – ATN/ISO 8208 (No Subnetwork Compression 3 – ATN/ISO 8473 (No Subnetwork Compression
6	Priority	Data Priority 0 – 3 as mapped in the VDL Mode 3 DLS frame
7 to N	DATA	An integral number of octets of data requested to be sent, defined by the NTVI.

3.2.2.2 Presentation Layer

This topic not applicable to this document.

3.2.2.3 Session Layer

This topic not applicable to this document.

3.2.2.4 Transport Layer

This topic not applicable to this document.

3.2.2.5 Network Layer

This topic not applicable to this document.

3.2.2.6 Data Link Layer

a) The A/G-SNS to PGNI-D interface **shall** [48] be implemented as the Single Link procedure defined within ISO 7776.

b) The Data Link Layer protocol for the A/G-SNS to PGNI-D Interface **shall** [50] be based on ISO/IEC 4335, the High-level Data Link Control (HDLC) Elements of Procedures.

The following subsections define the characteristics of the Data Link Layer.

3.2.2.6.1 HDLC Frame Structure

The basic unit of transmission is the frame, which is a bit sequence containing at least 32 bits between flags (eight address, eight control, and 16 frame check sequence bits).

a) All non-segmented messages or individual message segments (of a segmented message) sent between the A/G SNS and PGNI-D **shall** [52] be transmitted within one frame.
b) Transmissions **shall** [54] conform to the HDLC frame structure shown in Figure 3-1, HDLC Frame Structure.

Flag Sequence	Address	Control	Information	Frame Check Sequence	Flag Sequence
01111110	8 bits	8 bits	Variable - messages	16 bits	01111110

Figure 3-3

HDLC Frame Structure

3.2.2.6.2 Flag Sequence Field

a) The Flag (F) Sequence field **shall** [56] appear at the beginning and end of all frames.
b) The Flag (F) Sequence field **shall** [58] consist of one 0 bit followed by six contiguous 1 bits and one 0 bit.

The F field is used to mark the beginning and end of each frame. The F field at the end of the HDLC frame may serve as the start of the next HDLC frame.

3.2.2.6.2.1 Address Field

a) The Address (AD) field **shall** [60] consist of one octet.
b) The address field **shall** [62] be transmitted with the LSB first.
c) For the purposes of this interface, the AG-SNS **shall** [64] be defined as the DTE and the PGNI-D as the DCE.
d) The address field identifies the frame as either a command frame or a response frame. A command frame **shall** [66] contain the address of the station to which the command is being sent.
e) A response frame **shall** [68] contain the address of the station sending the frame.

3.2.2.6.2.1.1 A/G SNS and PGNI-D Addressing

a) The address field **shall** [70] be coded as per ISO 7776, Section 5.1.
b) In this case the codes for single link operation **shall** [72] be used, as shown in Table 3-11 below.

Table 3-11

A/G SNS and PGNI-D Addressing Format

Entity	Address Bit 1 2 3 4 5 6 7 8
DTE (A/G-SNS)	1 1 0 0 0 0 0 0
DCE (PGNI-D)	1 0 0 0 0 0 0 0

3.2.2.6.2.2 Control Field

a) The control field **shall** [74] contain one octet.
b) The control field **shall** [76] be encoded as per ISO 7776, Section 4.1.
c) Basic (modulo 8) operation **shall** [78] be implemented, supporting the three types of Control field formats, namely Information transfer format (I), Supervisory format (S) and Unnumbered Format (U).
d) The I format **shall** [80] be used to indicate the sequence number of an I frame.

This field enables re-transmission of lost frames as each one has a sequence number associated with it.
e) The Supervisory (S) format **shall** [82] be used to perform data link supervisory control functions such as acknowledging, requesting re-transmission and temporary suspension of transmission of I frames.
f) The Unnumbered (U) format **shall** [84] used to provide additional link control functions. In this case the U format will be used to implement link set up and disconnection.

3.2.2.6.2.3 Information Field

a) The Information (I) field of a frame **shall** [86] follow the CN field and precede the Frame Check Sequence.
b) Information may be in any sequence of bits. The I frame **shall** [88] contain the messages transferred between the A/G-SNS and the PGNI-D data port.
c) The I field **shall** [90] consist of an integral number of octets.

3.2.2.6.2.4 Frame Check Sequence Field

a) The Frame Check Sequence (FCS) field is a 16-bit field and **shall** [92] be used for frame error detection.

The Frame Check Sequence field is defined in ISO 3309.

3.2.2.6.2.5 Inter Frame Time Fill

a) The time between frames **shall** [94] be filled with flag characters, per ISO 3309.

3.2.2.6.3 Link Control Functions

a) The AG-SNS (DTE) **shall** [96] initiate the data link connection to the DCE (PGNI-D).

The state of the link is determined by the Link Control functions, which are defined in the following subsections: Link Set-up; Information Transfer; Link Disconnection and Link Exception Reporting.

b) These Link Control functions **shall** [98] operate using the link parameters defined in section 3.2.2.6.4, Link Level Parameters.

3.2.2.6.3.1 Link Set-up

a) The set up procedure **shall** [100]conform to ISO 7776 Section 5.3.1.
b) In a successful set up, the DTE **shall** [102] initiate link set up by transmitting an SABME command to the DCE.
c) The DCE **shall** [104] respond with a UA response, reset its send and receive variables and consider the link set up.
d) The DTE, after receiving the UA response, **shall** [106] check the T1 timer and if within the time limit will reset its send and receive variables and consider the link set up.

3.2.2.6.3.2 Information Transfer

a) Once the link set up has been completed, the DTE and DCE **shall** [108] transmit and receive I Frames as per ISO 7776 Section 5.4.
b) Under normal conditions the DTE **shall** [110] send I frames with the send frame sequence number N(S) set to that of the current send state variable V(S).
c) Upon reception the DCE **shall** [112] check this sequence number against the current receive state variable V(R).
d) If a valid match is made the frame **shall** [114] be accepted and acknowledged by setting the N(R) field to that of the value of the DCE receive state variable V(R) in the next transmitted frame.
e) The same procedure **shall** [116]be adopted in frames sent from the DCE to the DTE.

3.2.2.6.3.3 Link Disconnection

a) The Link Disconnection procedure **shall** [118] conform to ISO 7776 Section 5.3.4.
b) Either the DTE or DCE **shall** [120] be capable of disconnecting the link by transmitting a UA DISC command.
c) The initiator of the DISC **shall** [122] then receive back a UA response.
d) At the point of receipt of a UA response, the DISC **shall** [124] enter the Disconnected State.

3.2.2.6.3.4 Link Exception Reporting

a) Link Exception Reporting **shall** [126] conform to ISO 7776 Section 4.4.

There are numerous exception conditions described under Section 4.4.1 Busy Condition, Section 4.4.2 N(S) Sequence Error, Section 4.4.2.1 Checkpoint Recovery, Section 4.4.2.2 REJ Recovery, Section 4.4.2.3 Time Out Recovery, Section 4.4.3 Invalid Frame Condition and Section 4.4.4 Frame Rejection Condition.

3.2.2.6.4 Link Level Parameters

a) The A/G-SNS to GNI-D Interface Link Level Parameters are defined and **shall** [128] be in accordance with Table 3-12.

Table 3-12

Link Level Parameters

Parameter	Description	Min	Max	Default
N1	Maximum I Frame Length	8640 bits	16536 bits	8640 bits
N2	Maximum Number of Transmission Attempts	3	10	5
T1	Re-Transmission Timer	100ms	500ms	750ms
T2	Acknowledgement Timer	50ms	500ms	100ms
K	Maximum number of unacknowledged frames	1	7	4

3.2.2.7 Physical Layer

a) The A/G SNS/PGNI-D interface **shall** [130] implement the ANSI/EIA/TIA-530-A-1992 standard.

This standard specifies the electrical characteristics, connector and interchange circuits suitable for operation at all data rates below 2.1 Mbps and is intended for use in all applications requiring a balanced electrical interface. The standard is in alignment with ITU Recommendation V.24 and ISO 2110:1989/Amd. 1:1991.

3.2.3 Analog-type Interface

This topic not applicable to this document.

3.2.4 Discrete-type Interface

This topic not applicable to this document.

3.2.5 Interface Design Characteristics

Table 3-13, the Interface Design Characteristics table, provides a reference to all messages that traverse across the A/G SNS/PGNI-D interface.

Table 3-13

Interface Design Characteristics

Message	Paragraph	Size (Octets)	Source	Destination	HDLC Frame Type
Data-Burst		Variable	A/G SNS PGNI-D	PGNI-D A/G SNS	I

3.3 Physical Design Characteristics

The following subsections are used to define the physical characteristics of the A/G-SNS/PGNI-D Interface.

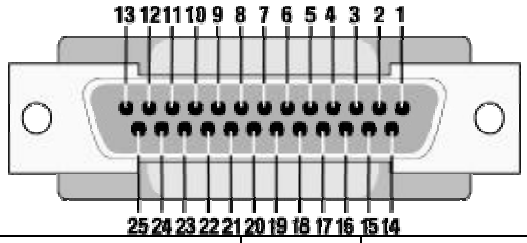
3.3.1 Electrical Power/Electronic Characteristics

3.3.1.1 Connectors

a) The EIA-530 interface **shall** [132] use 25 pin D type connectors with pin out as shown below in Table 3-14.

Table 3-14

EIA 530 Pin Connections



Pin	Signal	Pin	Signal
1	Shield	14	Transmitted Data Return
2	Transmitted Data	15	Transmit Signal Element Timing
3	Received Data	16	Received Data Return
4	Request to Send	17	Rec. Sig. Element Timer Return
5	Clear to Send	18	Local Loopback
6	DCE Ready	19	Request to Send
7	Signal Ground	20	DTE Ready
8	Received Line Signal Generator	21	Remote Loopback
9	Receiver Signal Element Timer	22	DCE Ready
10	Received Line Signal Detector	23	DTE Ready
11	Transmit Signal Element Timing	24	Trans. Sig Element Timing Return
12	Transmit Signal Element Timing	25	Test Mode
13	Clear to Send		

3.3.1.2 Wire/Cable

a) The required cable **shall** [134] be standard 25 way serial cable.

3.3.1.3 Electrical Power/Electronic Referencing (Grounding)

This topic not applicable to this document.

3.3.1.4 Fasteners

This topic not applicable to this document.

3.3.1.5 Electromagnetic Compatibility

This topic not applicable to this document.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

The interface requirements imposed by section 3 of this ICD shall be verified by use of the verification methods specified in paragraph 4.4. Verification methods and levels shall be applied in accordance with Appendix F, Table F-1, Verification Requirements Testability Matrix (VRTM).

4.2 Responsibility for Verification

FAA management has the responsibility for developing and implementing the verification of requirements for each project. FAA management may also delegate verification activities to other FAA organizations, independent contractors, and/or the prime project contractor.

4.3 Reserved

4.4 Verification Methods

The four verification methods that can be utilized in measuring equipment performance and compliance of requirements are as follows.

a) INSPECTION – Inspection is a method of verification to determine compliance without the use of special laboratory equipment, procedures, or services and consists of non-destructive static-state examination of hardware, software, and/or technical data and documentation.
b) TEST – Test is a method of verification wherein performance is measured during or after the controlled application of functional and/or environmental stimuli. Quantitative measurements are analyzed to determine the degree of compliance. The process uses standardized laboratory equipment, procedures and/or services.
c) DEMONSTRATION – Demonstration is a method of verification where qualitative determination of properties is made for a configuration item, including software and/or the use of technical data and documentation. The items being verified are observed, but not quantitatively measured, in a dynamic state.
d) ANALYSIS – Analysis is a method of verification where hardware or software designs are compared with known scientific and technical principles, procedures, and practices to estimate the capability of the proposed design to meet the mission and system requirements.

5.0 PREPARATION FOR DELIVERY

NEXCOM equipment will be delivered in accordance with section F of the contract/SOW.

6.0 NOTES

6.1 Definitions

This topic not applicable to this document.

6.2 Abbreviations and Acronyms

The list of abbreviations and acronyms may be found in appendix B.

APPENDIX A

Verification Requirements Testability Matrix (VRTM)

Table A-1

Verification Requirements Testability Matrix

Verification Method					
Paragraph		Inspection	Analysis	Test	Demonstration
3.2.2.1.1	The A/G-SNS **shall** [2] send and receive Application Data Units (ADU's) to and from the PGNI-D Port.				
3.2.2.1.1	These ADU's **shall** [4] be encapsulated as information frames using the LAPB (ISO 7776) link level protocol, which provides peer to peer data integrity.				
3.2.2.1.1	All non-segmented messages or individual message segments (of a segmented message) sent between the PGNI-D and A/G-SNS **shall** [6] be transmitted within one frame.				
3.2.2.1.1.1	A message **shall** [8] be contained within an I field of a I frame.				
3.2.2.1.1.1	Each message exchanged across the data interface **shall** [10] contain a one octet Message ID followed by the message.				
3.2.2.1.1.1	The message format diagrams in the remainder of this section specify bit 1 of each octet **shall** [12] be the first bit transmitted.				
3.2.21.1.2	This ADU **shall** [14] be sent by the PGNI-D during the VDL Mode 3 Net Entry procedure and indicates to the A/G-SNS that the aircraft can be reached through this PGNI-D.				
3.2.2.1.1.2.1	The A/G SNS will check the connection status of the aircraft based on the ICAO address and **shall** [16] respond with an Aircraft Status Message with either a "previous link known" or "previous link unknown" content.				
3.2.2.1.1.2.2	The Data Link Capability Message **shall** [18] be generated by the PGNI-D during initial link negotiation.				
3.2.2.1.1.2.3	The Downlink Data Message contains the ADU received from the aircraft and **shall** [20] be sent by the PGNI-D to the A/G-SNS interface.				
3.2.2.1.1.2.3	It **shall** [22] be an unacknowledged message at the application layer and will contain the following fields.				
3.2.2.1.1.2.4	The Uplink Delivery Notification **shall** [24] be sent to the A/G-SNS by the PGNI-D after an Uplink Data Message has been successfully delivered to the MDR for transmission.				

3.2.2.1.1.2.5	The Message Rejection Notification **shall** [26] be generated and sent to the A/G-SNS by the PGNI-D in response to an uplink data message that was unable to be delivered to the MDR for transmission.				
3.2.2.1.1.2.6	The Ground DTE Address **shall**[28] be passed to the AG-SNS after the LAPB link has initialized.				
3.2.2.1.1.2.6	The Ground DTE Address **shall**[30] have a total length of 3 Binary Coded Decimal (BCD) digits, as follows:				
3.2.2.1.1.2.6	$X_0X_1X_2$ (X_0 **shall**[32] be the most significant digit)				
3.2.2.1.1.2.6	The Ground DTE address **shall**[34] be in the range of 0 through 255.				
3.2.2.1.1.2.6	The four MSB's **shall**[36] be filled with zeros, as only 4 bits of the first octet are required.				
3.2.2.1.1.2.1	The Aircraft Link Status Message **shall** [38] be generated by the A/G-SNS interface in response to the Aircraft State Message.				
3.2.2.1.1.3.1	The PGNI-D **shall** [40] receive a Previous Link Known message from the A/G-SNS in response to the Aircraft State Message when the aircraft is already currently connected to the A/G Router served by the A/G-SNS.				
3.2.2.1.1.3.1	If the A/G router does not recognize the previous link to the aircraft, a Join Event message will be initiated by the A/G router and a Previous Link Unknown message **shall** [42] be sent to the PGNI-D.				
3.2.2.1.1.3.2	The Aircraft Data Request Message contains the ADU received from the ATN router and **shall** [44] be passed from the A/G SNS to the PGNI-D.				
3.2.2.1.1.3.2	The Uplink Data Message **shall** [46] be acknowledged from the PGNI-D by either an Uplink Delivery Notification or Uplink delivery Rejection Message and will contain the following fields.				
3.2.2.6	The A/G-SNS to PGNI-D interface **shall** [48] be implemented as the Single Link procedure defined within ISO 7776.				
3.2.2.6	The Data Link Layer protocol for the A/G-SNS to PGNI-D Interface **shall** [50] be based on ISO/IEC 4335, the High-level Data Link Control (HDLC) Elements of Procedures.				
3.2.2.6.1	All non-segmented messages or individual message segments (of a segmented message) sent between the A/G SNS and PGNI-D **shall** [52] be transmitted within one frame.				
3.2.2.6.1	Transmissions **shall** [54] conform to the HDLC frame structure shown in Figure 3-1, HDLC Frame Structure.				
3.2.2.6.2	The Flag (F) Sequence field **shall** [56] appear at the beginning and end of all frames and **shall** [58]consist of one 0 bit followed by six contiguous 1 bits and one 0 bit.				
3.2.2.6.2.1	The Address (AD) field **shall** [60]consist of one octet.				
3.2.2.6.2.1	The address field **shall** [62] be transmitted with the LSB first.				

3.2.2.6.2.1	For the purposes of this interface, the AG-SNS **shall** [64] be defined as the DTE and the PGNI-D as the DCE.				
3.2.2.6.2.1	The address field identifies the frame as either a command frame or a response frame. A command frame **shall** [66] contain the address of the station to which the command is being sent.				
3.2.2.6.2.1	A response frame **shall** [68] contain the address of the station sending the frame.				
3.2.2.6.2.1.1	The address field **shall** [70] be coded as per ISO 7776, Section 5.1.				
3.2.2.6.2.1.1	In this case the codes for single link operation **shall** [72] be used, as shown in the table below.				
3.2.2.6.2.2	The control field **shall** [74] contain one octet and **shall** [76] be encoded as per ISO 7776, Section 4.1.				
3.2.2.6.2.2	Basic (modulo 8) operation **shall** [78] be implemented, supporting the three types of Control field formats, namely Information transfer format (I), Supervisory format (S) and Unnumbered Format (U).				
3.2.2.6.2.2	The I format **shall** [80] be used to indicate the sequence number of an I frame. This field enables re-transmission of lost frames as each one has a sequence number associated with it.				
3.2.2.6.2.2	The Supervisory (S) format **shall** [82] be used to perform data link supervisory control functions such as acknowledging, requesting re-transmission and temporary suspension of transmission of I frames.				
3.2.2.6.2.2	The Unnumbered (U) format **shall** [84] used to provide additional link control functions. In this case the U format will be used to implement link set up and disconnection.				
3.2.2.6.2.3	The Information (I) field of a frame **shall** [86] follow the CN field and precede the Frame Check Sequence.				
	The I frame **shall** [88] contain the messages transferred between the A/G-SNS and the PGNI-D data port.				
3.2.2.6.2.3	The I field **shall** [90] consist of an integral number of octets.				
3.2.2.6.2.4	The Frame Check Sequence (FCS) field is a 16-bit field and **shall** [92] be used for frame error detection. The Frame Check Sequence field is defined in ISO 3309.				
3.2.2.6.2.5	The time between frames **shall** [94] be filled with flag characters, per ISO 3309.				
3.2.2.6.3	The AG-SNS (DTE) **shall** [96] initiate the data link connection to the DCE (PGNI-D).				
3.2.2.6.3	These Link Control functions **shall** [98] operate using the link parameters defined in section 0, Link Level Parameters.				
3.2.2.6.3.1	The set up procedure **shall** [100] conform to ISO 7776 Section 5.3.1.				
3.2.2.6.3.1	In a successful set up, the DTE **shall** [102] initiate link set up by transmitting an SABME command to the DCE.				

3.2.2.6.3.1	The DCE **shall** [104] respond with a UA response, reset its send and receive variables and consider the link set up.				
3.2.2.6.3.1	The DTE, after receiving the UA response, **shall** [106] check the T1 timer and if within the time limit will reset its send and receive variables and consider the link set up.				
3.2.2.6.3.2	Once the link set up has been completed, the DTE and DCE **shall** [108] transmit and receive I Frames as per ISO 7776 Section 5.4.				
3.2.2.6.3.2	Under normal conditions the DTE **shall** [110] send I frames with the send frame sequence number N(S) set to that of the current send state variable V(S).				
3.2.2.6.3.2	Upon reception the DCE **shall** [112] check this sequence number against the current receive state variable V(R).				
3.2.2.6.3.2	If a valid match is made the frame **shall** [114] be accepted and acknowledged by setting the N(R) field to that of the value of the DCE receive state variable V(R) in the next transmitted frame.				
3.2.2.6.3.2	The same procedure **shall** [116]be adopted in frames sent from the DCE to the DTE.				
3.2.2.6.3.3	The Link Disconnection procedure **shall** [118] conform to ISO 7776 Section 5.3.4.				
3.2.2.6.3.3	Either the DTE or DCE **shall** [120] be capable of disconnecting the link by transmitting a UA DISC command.				
3.2.2.6.3.3	The initiator of the DISC **shall** [122] then receive back a UA response and at that point **shall** [124] enter the Disconnected State.				
3.2.2.6.3.4	Link Exception Reporting **shall** [126] conform to ISO 7776 Section 4.4.				
3.2.2.6.3.4	The A/G-SNS to GNI-D Interface Link Level Parameters are defined and **shall** [128] be in accordance with 3-12.				
3.2.2.7	The A/G SNS/PGNI-D interface **shall** [130] implement the ANSI/EIA/TIA-530-A-1992 standard.				
3.3.1.1	The EIA-530 interface **shall** [132] use 25 pin D type connectors with pin out as shown below in Table 3-14.				
3.3.1.2	The required cable **shall** [134] be standard 25 way serial cable.				

APPENDIX B

Abbreviations and Acronyms

A/G SNS	Air/Ground Sub Network Services
ADU	Application Data Unit
ANSI	American National Standards Institute
ATN	Aeronautical Telecommunications Network
CLNP	ConnectionLess Network Protocol
DCE	Data Communications Equipment
DLS	Data Link Service
DTE	Data Terminal Equipment
EST	Eastern Standard Time
FAA	Federal Aviation Administration
HDLC	High Level Data Link Control
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ISO	International Organization of Standardization
ITU	International Telecommunications Union
IW	Internetworking Function
LAPB	Link Access Balanced Mode
MASP's	Signal in Space Minimum Aviation System Performance Standards
MDR	Multimode Digital Radio
PGNI-D	Primary Ground Network Interface - Data
PGNI-V	Primary Ground Network Interface - Voice
PLP	Packet Layer Protocol
RIU	Remote Interface Unit
SABM	Set Asynchronous Balanced Mode
SARP's	Standards And Recommended Practices
SGNI-D	Secondary Ground Network Interface - Data
SRD	System Requirements Documents
TDMA	Time Division Multiple Access
UI	Unnumbered Information
VDL	VHF Digital Link
VHF	Very High Frequency